

JSC Fastener Integrity Testing Program

NT/Flight Equipment Division

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Revision E

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**National Aeronautics and
Space Administration**

**Lyndon B. Johnson Space Center
Houston, Texas**

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PREFACE

This publication establishes the requirements necessary to test and ensure the integrity of externally threaded fasteners used in NASA programs. Questions related to the contents of this publication should be directed to the GFE Assurance Branch, Code NT3, JSC.

All previous version are cancelled.

Approved:

Original Signed by
Vincent D. Watkins, Chief,
Government Furnished Equipment Branch

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Change Record

Revision	Date	Originator/Phone	Description
Baseline	unknown	unknown	No history on file with STIC
A	5/90	unknown	No history on file with STIC
B	2/91	I.S. Alexander	No history on file with STIC
C	6/92	Elmer R. Johnson	No history of description
D	01/26/2000	Vincent D. Watkins 483-4348	<ul style="list-style-type: none"> • Changes were initiated to address issues identified by JCAR 107. • Details were added to address in-house manufactured fasteners. • A question and answer section was added. • Exception was added for fasteners too short for tensile and for which no definitive hardness req. exist.
E	10/22/2001	Daniel P. Hartgerink 483-1081	<ul style="list-style-type: none"> • Section 1.0: Reference to “At No Cost” was removed and correction of controlling division was made. • Sections 7.5.2, 7.5.3, 7.5.4, A3.0, and A4.0: Clarifications made and redundant statements removed.

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1.0 **PURPOSE.** This document establishes the minimum requirements necessary to ensure fastener integrity through a program of testing to be performed prior to fastener use on NASA space flight programs. This testing can be obtained through the NASA Johnson Space Center (JSC) Receiving Inspection and Test Facility (RITF) (see Appendix A). The requirements set forth in this document do not relieve the manufacturers of their obligation to perform certification testing. Questions one may have about the fastener testing/integrity program are asked and answered below.

1. *Question:* Why is it necessary to test fasteners used in NASA space flight programs?

Answer: While manufacturers of military grade fasteners are required to test their products, NASA tests fasteners prior to their use to verify their chemistry and mechanical properties to ensure that no mistakes were made and/or shortcuts taken in the manufacturing process. In the aerospace industry, which is known for very low margins of safety, small differences in material strength can be the difference between success and failure.

2. *Question:* Is this testing necessary when a certificate of conformance (C of C) and material test report (MTR) are received with the purchase?

Answer: Yes. Various specifications allow for the manufacture of a specific part from several different materials ranging from low-alloy steel, to corrosion-resistant steel, to heat-resistant steel. This testing provides additional verification that the fasteners are, indeed, fabricated as intended.

Additionally, most procurements are made through a distributor, which adds one more step at which errors in the procurement process can be made. This is exemplified by a past failure on critical ground support equipment (GSE). Hardness testing could have identified the problem that caused the failure and prevented the use of the GSE fasteners.

3. *Question:* Should fasteners manufactured by NASA in house or by NASA contractors be tested?

Answer: Yes, if required to meet the certification requirements. Even though such fasteners are manufactured to controlled drawings and using certified stock, they are often subjected to specific processes to adjust/alter the mechanical properties through heat treating. Subsequent to such processes, verification of the subject mechanical properties should be verified by the design function.

2.0 **SCOPE.** The procedures in this publication apply to all NASA space flight and critical GSE fasteners. This publication defines the minimum requirements for testing externally threaded fasteners procured for use on NASA programs to verify the manufacturer's compliance with procurement specifications.

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3.0 APPLICABLE DOCUMENTS (CURRENT REVISIONS).

1. ASTM F606, Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets.
2. ASTM F606M, Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric).
3. NPD 8730.2, Basic Policy for Mechanical Parts Control.

4.0 REFERENCE DOCUMENT.

1. JSC letter ND5/89-L034, Bolt and Fastener Problems.
2. JSC 26549, Johnson Space Center Manual for the Control of Program Stock

5.0 DEFINITION OF TERMS.

1. Critical GSE fastener. Fastener whose failure can result in injury to personnel, damage to flight hardware, and/or damage to facilities.
2. Externally threaded fastener. Any screw, bolt, or stud having external threads.
3. Lot. A quantity of fasteners of one part number fabricated by the same production process from the same coil or heat number of metal, provided by the metal manufacturer, and submitted for inspection and testing at one time.
4. Structural fastener. A fastener used in either the primary or secondary load path of a structure.

6.0 FASTENERS THAT MUST BE TESTED. All space flight and critical GSE externally threaded fasteners, sizes #8 and larger, procured from fastener distributors or manufacturers must be tested. Testing requirements may be waived at the discretion of the JSC GFE Branch and the JSC Materials and Processes Branch for specialized or custom fasteners for which adequate documentation of manufacturer testing exists. Requests for waivers should be submitted on JSC Form 1715 and addressed to the Chief, GFE Assurance Branch.

Fasteners manufactured in house from certified raw stock using controlled fabrication processes and structurally altered or previously verified fasteners for which the C of C and MTR's have been obtained, will be excluded from these testing requirements. However they may be subject to separate testing when deemed necessary to support the flight hardware structural certification. Verification of the mechanical properties shall be the responsibility of the design function.

Exceptions: Specifically excluded from these testing requirements are nuts, nut plates, set screws, sheet metal screws, guide pins, nonmetallic fasteners, and helicoil wire, or other inserts.

7.0 TEST REQUIREMENTS. This section describes the testing methodology approved by JSC for determining fastener acceptability. It describes receiving provisions, lot sampling, and testing requirements.

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7.1 FASTENER TESTING.

7.1.1 Test Facilities. Contractors may test fasteners at their test facilities or have them tested at qualified third-party test facilities in accordance with the requirements set forth in this document. Documented test results shall be made available to the test initiator, procuring organization and/or NASA. A contractor may elect to have the JSC Receiving, Inspection and Test Facility (RITF) to perform this service. The services of the JSC RITF are made available to all JSC divisions and JSC contractors. Services requested by JSC contractors must be in support of existing NASA programs or with prior arrangement with the Occupational Safety and Institutional Assurance Division (see Appendix A). Fasteners received from a JSC contractor or NASA facility that have evidence of testing by the receiver in accordance with the requirements of this document do not need to be retested.

7.1.2 Sampling and Lot Traceability. Incoming lots or in-house manufactured bolts are placed in a holding area until required receiving inspection and testing are complete. All test lot samples are to be stored in a controlled area when not in use. Samples shall be selected at random according to the schedule tabulated below. Each test lot sample shall be packaged and identified separately so as to maintain lot traceability to the manufacturer. A lot traceability number will accompany each test lot sample at all times.

Minimum Sample Sizes Per Lot Size

<u>Lot Size</u>	<u>Sample Size</u>
1-100	2
101-500	3
501 and over	5

7.2 TEST REQUIREMENTS. At a minimum, all fasteners to be tested must undergo a chemical analysis, an ultimate tensile test, and/or a hardness test. Each lot shall have its samples examined for lot homogeneity. The tensile test may be waived for fasteners of a length insufficient for testing (refer to the testing specification cited by the procurement document). For those samples too short for tensile testing and for which the hardness requirements are too vague for definitive acceptance, acceptable chemical analysis in addition to the C of C and MTR's shall be the basis for approval. Testing shall be performed to the procedures called out in the procurement specification, and results shall agree with the requirements of the procurement specification. Should the procurement specification fail to identify specific test procedures, mechanical tests are to be performed in accordance with ASTM F606 or ASTM F606M as appropriate. If specific requirements for the mechanical properties cannot be definitively identified, the "pass/fail" will be noted as "N/A", and the acceptability will be decided by the end user.

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7.3 TRAINING AND QUALIFICATION. All laboratory personnel performing testing and inspection operations shall be trained and qualified to perform the required test procedures. Records shall be maintained for training, testing, and certification status of all personnel.

7.4 EQUIPMENT CALIBRATION. All equipment is calibrated to known standards that are traceable to the National Institute of Standards and Technology. Proof of equipment calibration status shall be maintained with the equipment.

7.5 TEST PROCEDURES.

7.5.1 Tensile Testing. Destructive ultimate tensile tests shall be performed on test lot samples where possible. Any test lot sample not meeting the tensile properties required shall be noted on the test report. For those samples that exceed our tensile test capability to take the fastener to failure, proof testing may be conducted..

7.5.2 Chemical Analysis. The chemical analysis shall verify that the test lot samples' elemental compositions are within the tolerances allowed by the applicable material specifications. Any test lot sample not meeting the chemical property requirements shall be noted on the test report.

7.5.3 Hardness Testing. Destructive hardness tests shall be applied to all fastener lots sampled that are nominally #8 inch in diameter and larger. Those samples smaller submitted for test are tested using Rockwell superficial and microhardness testing methods. Any test lot sample not meeting the hardness property requirements shall be noted on the test report.

7.5.4 Lot Homogeneity. The test results for each fastener shall be compared to those for other fasteners within the lot sample. Test data suggesting that more than one lot of fasteners is present shall be noted on the test report.

8.0 DISPOSITION OF TEST LOT SAMPLES. Test lot samples will be maintained a minimum of 90 days following completion of testing. Test lot samples that fail the required material properties testing will be maintained in a controlled area for at least 1 year from the date of testing.

9.0 TEST RESULTS ANALYSES. The test facility will collect and evaluate all test data against the requirements of the fastener specification. The report submitted to the test initiator, procuring organization, and/or NASA will identify any sample not meeting the required material specifications.

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APPENDIX A

JSC RECEIVING INSPECTION TEST FACILITY (RITF) SERVICES

A1.0 GENERAL. Test requests are to be submitted to the RITF using Form JSC 1264A, Material Test Request. Any fastener testing performed for purposes other than lot verification (for example, proof testing and design validation) must be clearly identified on the test report.

A2.0 TEST SAMPLE DELIVERY TO RITF. JSC facilities and contractors are responsible for delivering test samples to the RITF.

A3.0 RECEIVING. Fastener lots received at a JSC onsite bonded stores location are handled in accordance with approved receiving procedures. The date of receipt will be recorded along with relevant information from the Form 1264A.

A4.0 PRIORITY REQUESTS. RITF testing will be provided on a “first-come-first-served” basis. Priority testing is defined as testing that requires rescheduling of existing test requests to accommodate customer scheduling deadlines. As a general rule, the RITF will require a minimum of 3 working days to process a test request and prepare the final test report for quantities of 10 fasteners or less.

NASA-initiated priority test requests will require the signature approval of a branch chief or higher. Contractor-initiated priority test requests will require the signature approval of the contractor management. The Mechanical Lead or his/her designee will be the final authority of approval for priority test requests.

A5.0 RITF-TESTED FASTENERS. Test lot samples submitted to the RITF for analysis will become the property of the RITF and will not be returned without the concurrence of the RITF Technical Manager or his/her designee.

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APPENDIX B

EXTERNAL FASTENER PROPERTY REFERENCE

This information is provided for reference purposes only and should not be interpreted as an authorized parts list. The user should always refer to the proper procurement and material specification for complete information.

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